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Hypomagnesaemia in Sheep

BY

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SUMMARY.—Observations were made on the changes in the average serum magnesium levels in sheep over fairly prolonged periods and attempts were made to correlate these changes with season, variations in the climatic conditions, changes in the conditions of pasturage, and certain changes in the composition of pasturage. Variations in the serum magnesium levels of individual sheep were observed and also the effects of pregnancy, lactation, and short periods of fasting. Similar studies were also made in respect of changes in serum calcium levels.

Climatic factors of importance in causing hypomagnesaemia in sheep appear to be (1) rising temperatures in spring together with considerable rainfall producing conditions for rapid growth of herbage, and (2) low temperature conditions particularly when associated with snowfall and consequent shortage of food, this effect being seen in February and March in our observations. Fasting experiments showed that quite a short fast will cause hypomagnesaemia and suggest that shortage of food under adverse weather conditions is an important factor in hypomagnesaemia.

Considerable variation in serum magnesium levels was noted among individuals, some maintaining particularly low levels and others showing wide fluctuations.

Chemical examination of the herbage in spring and early summer failed to show a correlation between the magnesium content of the herbage and the fluctuations in average serum magnesium levels at this time. However, in late May and June as the fibre content of the herbage increased and the crude protein continued to decrease the serum magnesium levels rose into a higher range.

Although individual variation occurred there was a tendency for serum calcium levels to be a little lower during February, March, and April and around the time of parturition than at other times, but calcium levels did not vary closely with temperature and rainfall changes as did magnesium. However, blood samples from outbreaks of hypomagnesaemic tetany indicated that the hypomagnesaemia was accompanied by a hypocalcaemia in a proportion of cases, and that clinical cases occurred when flock average serum magnesium levels were at their low points.

CLINICAL symptoms of hypomagnesaemia, sometimes called grass tetany or grass staggers, is now recognised as a problem in sheep in a number of countries.

In Australia, Blumer *et al.* (1939) reported a high incidence of grass staggers in breeding ewes pastured on lush grazing following the winter rains. Combined injections of calcium and magnesium were curative. Hypomagnesaemia in sheep with clinical symptoms was recorded in Scotland by Stewart (1952). The outbreak caused heavy losses and it was associated with bad weather at lambing time. In another communication, Stewart (1954) stated that the incidence of the condition was increasing and it occurred in April and May in hill and lowland flocks whose diets were very different. He also remarked that tetany occurred in individuals only where there was a marked general hypomagnesaemia in the flock.

Hypomagnesaemic tetany has been described in the south of England by Pook (1955) and Penny &

Arnold (1955). In both outbreaks the condition was associated with the grazing of grass leys which had been dressed with artificial manures. The sheep described by Pook were ewes nursing twin lambs; the outbreak took place at the end of March. The flock of ewes in Penny and Arnold's account showed symptoms after 2 days' grazing of the ley pasture; this outbreak ceased when the ewes were returned to old pasture. The affected sheep in this latter outbreak had low blood calcium and phosphorus levels as well as hypomagnesaemia.

The causes of hypomagnesaemic tetany in sheep are obscure and although symptoms appear to occur only when blood magnesium levels are low the factors that influence these levels are uncertain.

The investigations which are the subject of this article were undertaken to see if further information on the problem could be obtained. They comprise the examination of serum magnesium levels in two flocks of sheep over prolonged periods of time, and the possible association of the levels with season, weather, pregnancy and lactation, fasting, and certain components of the herbage. Some results are included from naturally occurring hypomagnesaemic tetany in a number of other flocks. During the course of the studies some examinations of serum calcium were also undertaken.

Methods and Procedure

Blood samples were taken from the jugular vein, allowing the blood to flow from the sampling needle directly into a screw-cap bottle.

Serum magnesium was estimated by the method of Heagy (1948) in the early stages of the observations, latterly the method of Neill and Neely (1956) was used. Serum calcium was estimated by the method of Mulligan and Jennings (1953). For serum phosphorus the phosphomolybdate method of Fiske and Subbarow (1925) was used.

In herbage fibre was estimated by the Henneberg Acid Gravimetric method; crude protein was estimated by the Kjeldahl method and magnesium by precipitation as magnesium ammonium phosphate.

Meteorological data was supplied by the Meteorological Office, Civil Airport, Renfrew.

The details of the two flocks studied were as follows:—

(a) Blood magnesium levels were followed in 10 aged Scottish Blackface ewes on a permanent pasture on a lowland farm from October, 1954, to July, 1955. The pasture was very poor in late winter and early spring and the sheep were given a daily supplement of 1¼ lb. of hay per head from the 13th January to the beginning of March. They lambed in the first half of April.

(b) Forty young half-bred ewes on a lowland farm were studied from January to the end of May in 1956 and again in 1957 from February to the beginning of June. In both years the winter management of this flock comprised grazing on grass with a supplement of hay and concentrates (oats 3 parts, linseed cake 1 part, white fish meal ½ part), fed from the beginning of February to the middle of March. Little of the hay was eaten but about 1¼ lb. of concentrates per head per day were consumed. Lambing took place in late March and early April.

Results

Sheep with Hypomagnesaemic Tetany

Table I shows the serum Mg and Ca levels in a number of sheep in which hypomagnesaemic tetany was suspected and a hypomagnesaemia was confirmed. Clinicians usually submit a small number of blood samples from a flock and the figures in the table refer to the sample with the lowest Mg value in the group of sheep examined in the flock. A limited number of samples were examined for serum inorganic phosphorus but owing to the condition of the samples this was not possible in the remainder.

TABLE I

LOWEST INDIVIDUAL SERUM MAGNESIUM LEVEL IN GROUPS OF SHEEP FROM FLOCKS WHERE DEATHS DUE TO SUSPECTED HYPOMAGNESAEMIC TETANY HAD OCCURRED, AND WHERE A HYPOMAGNESAEMIA WAS CONFIRMED, TOGETHER WITH THE SERUM CALCIUM LEVELS OF THE SAME ANIMALS AND IN SOME INSTANCES THE INORGANIC PHOSPHORUS LEVEL

(1) Date	(2) Case No.	(3) Serum magnesium in mg. per 100 ml. serum	(4) Serum calcium in mg. per 100 ml. serum	(5) Serum inorganic phosphorus in mg. per 100 ml. serum
22/4/55	102/55	0·75	10·0	—
26/4/55	108/55	0·61	9·9	—
3/5/55	119/55	0·25	6·4	—
9/5/55	132/55	0·56	9·3	—
11/4/56	130/56	0·82	4·3	6·0
12/4/56	145/56	1·05	7·8	4·5
6/6/56	224/56	1·03	10·4	—
13/9/56	298/56	1·07	9·8	8·0
29/3/57	113/57	1·0	6·9	—
2/4/57	119/57	0·92	6·8	6·3

Most of these cases occurred in April and May, but one case was confirmed in June, 1956, one in September, 1956, and one in March, 1957. In about half of these outbreaks the serum calcium levels were also below normal and one (Case No. 130/56) was as low as 4.3 mg. per 100 ml. serum. The few samples examined for inorganic phosphorus were within the normal range.

In one outbreak (Case No. 132/55), in which deaths were occurring it was possible to examine 15 blood samples from the flock. The average values obtained were 1.6 mg. per 100 ml. serum for magnesium, with the highest value of 2.55 mg. per 100 ml. and the lowest of 0.56 mg. per 100 ml. The average Ca value was 9.14 mg. per 100 ml. serum, the range being 6.35-9.9 mg. per 100 ml.

Experimental Observations

Changes in Average Serum Magnesium and Calcium Levels in Relation to Season and Weather.

(a) *Scottish Blackface Flock.* Fig. 1 shows the changes in the average serum magnesium and calcuim levels in this flock of aged ewes between October, 1954 and July, 1955, and the temperature and rainfall

records for the same period. Mg levels were at their maxima in December, and there was a general tendency to fall during the succeeding months to the lowest levels in May, but there were marked fluctuations during this period. There were steep drops in average serum magnesium levels at the time of snowfalls on January 21st, February 16th and March 23rd. At these times the grazing was very sparse and the supplement was well below maintenance level. The most severe fall in levels took place in May, during a fortnight of mild growing weather following substantial rainfall early in the month. Later in May and in June, the magnesium levels rose during a period of dry warm weather, to be succeeded by another slight fall following wet mild weather in July.

There was a drop in serum calcium levels in the spring, the lowest levels occurring in March and April. The average serum calcium fall was much less than that of magnesium when considered on a percentage basis.

Lowest calcium levels occurred in late pregnancy and about the time of parturition and they did not fluctuate in relation to weather as the magnesium levels appeared to do.

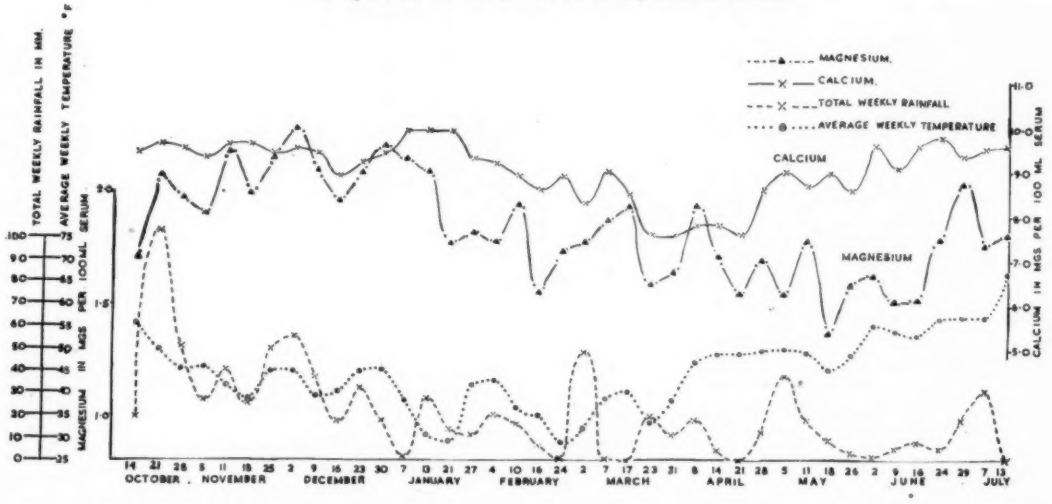
of average serum magnesium which came after rain and mild weather in the week ending May 10th.

Serum calcium levels in this set of observations showed a pattern very similar to that of the Scottish Blackface ewes described above. The serum calcium levels dropped in the spring but in these half-bred ewes the fall was relatively small and the lowest average levels were found between February and April.

The results of observations on this flock between February and June, 1957, are presented in Fig. 3. During this period the lowest points in the average magnesium levels occurred in the second half of February towards the end of March, and in the first half of May, the lowest level again being in May. The fall in February took place during cold weather when there was a considerable snowfall. After the average mean daily temperature had reached about 45° F. or over during late March, April and May, sharp falls in magnesium levels followed or occurred during weeks of considerable rainfall. A rise in magnesium levels followed the night frosts and rather low temperatures during the week ending May 9th.

Individual Variation in Serum Magnesium and

FIG. 1.—Average serum calcium and magnesium levels of Scotch blackface flock in mg. per cent. average weekly temperature in °F. and total weekly rainfall in mm.



(b) *Half-bred Flock.* Fig. 2 shows that the sheep in 1956 had a fluctuating downward trend in average serum magnesium levels from February to the lowest in May. There was a minor drop in magnesium levels following very cold weather in February, but the more serious fall commenced after mild weather and rain in the week ending March 5th. A drop in temperature about March 12th appeared to check the fall temporarily (there was a severe frost on March 14th which checked pasture growth). The decline in values then continued until a rise occurred during dry weather in the second half of April. This was followed by the lowest level

Calcium Levels and their Relation to Pregnancy and Lactation.

Eight pregnant and 2 non-pregnant aged Scottish Blackface ewes were maintained under the same conditions and grazed on the same pasture. Figs. 4 and 5 show the average weekly levels of serum magnesium and calcium for the group compared with certain individual sheep.

Fig. 4 (top half) shows the average weekly changes in serum magnesium and calcium levels of the group compared with 2 non-pregnant ewes, S 17 and S 21. Serum magnesium values for the 2 non-pregnant sheep followed much the same pattern as

FIG. 2.—Average serum magnesium and calcium levels of half-bred flock, average weekly temperature, and total weekly rainfall.

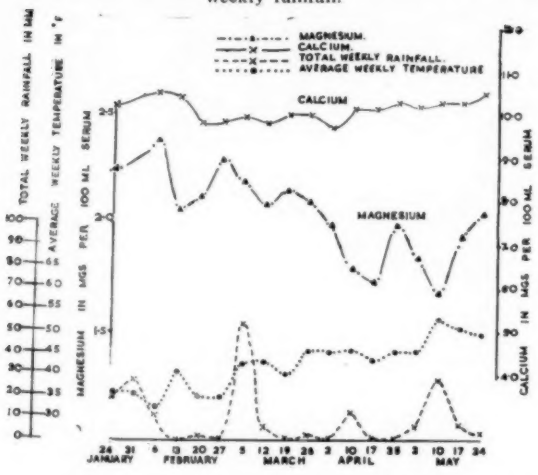
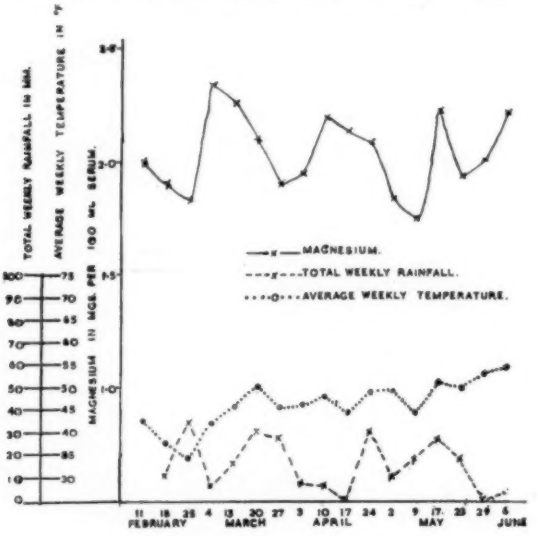


FIG. 3.—Average serum magnesium levels of half-bred flock, average weekly temperature, and total weekly rainfall.



the average values for the flock although at certain times they tended to be well below this average. The calcium values also were usually below the average of the group and at times they were much lower. It should be noted that the 2 sheep, S 17 and S 21, were old and in very poor condition.

Fig. 4 (lower half) shows the average weekly changes in the serum magnesium and calcium levels of the ewes together with the individual values of ewes S 25 and S 27 who had born and suckled twin lambs. The magnesium levels in these 2 animals tended to follow the average changes in the flock, but those of S 27 were nearly always above the average whereas those of S 25 were usually below the average and fell to a dangerous level in April and May when the average levels were at their lowest. The serum calcium levels of these 2 individuals followed the average values for the group fairly closely although they fluctuated from time to time. S 27 had a somewhat low serum calcium level in early July.

Fig. 5 (top half) illustrates the average weekly results of magnesium and calcium examinations of the same flock compared with the results in two ewes S 14 and S 19 with single lambs. The magnesium levels of S 14 were always above the average for the flock, whereas S 19 was almost invariably below the average and sometimes it reached very low levels. Nevertheless the magnesium results in both sheep tended to follow the average fluctuation for the flock as a whole. S 14 and S 19 had shown a similar pattern of levels in the previous year. The calcium levels in S 14 were somewhat low in April and May, and S 19 showed considerable fluctuations in April, but over the period as a whole both sheep followed the average pattern of the flock.

Fig. 5 (lower half) compares the serum magnesium and calcium levels of ewe S 20 with the average levels of the flock. This ewe had nursed twin lambs and died of suspected hypomagnesaemic tetany on April 28th. Her serum magnesium level was well below the flock average in the week following February 16th, when the flock level was low, and it again fell to a dangerously low level in the week before the flock level fell on April 21st. The final sample which showed a magnesium level of 1.07 mg. per cent. was taken at death and probably does not show the extreme low level reached. Unusually wide fluctuations in magnesium levels were observed in S 20 and records for the previous year showed that the magnesium levels of this ewe were very much below the flock average at times of low average levels. While the serum calcium level of this ewe followed the flock average during the six months before death in April, a somewhat low value had occurred in the previous October. This sheep had shown a tendency to low serum calcium levels from time to time in the previous year, and these low figures all coincided with low average serum magnesium levels in the flock. At the time of death the calcium level of this sheep was extremely low, being 3.4 mg. per cent.

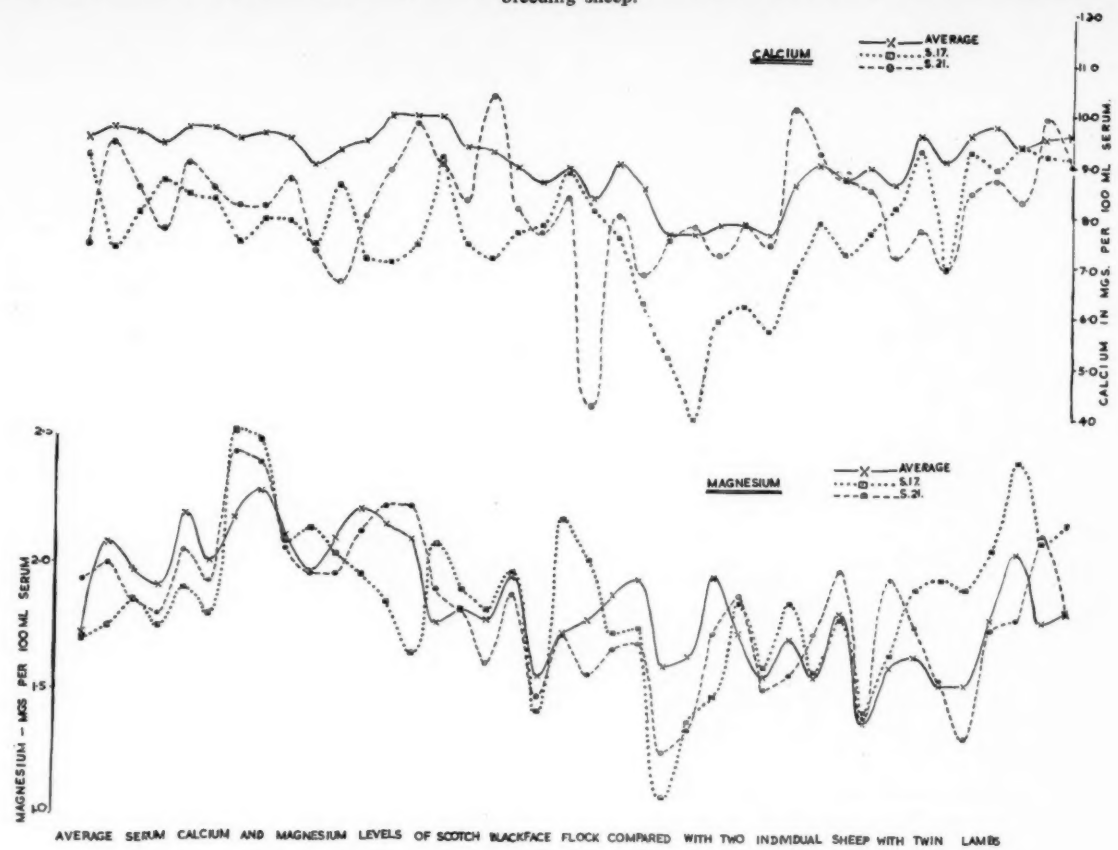
Effect of Pregnancy and Suckling.

The evidence obtained from the Scottish Blackface flock suggests that the pattern of serum magnesium levels was very similar in pregnant and non-pregnant sheep.

Weekly changes in serum magnesium levels of a group of nine breeding and eight non-breeding 3-year-old half-bred ewes are given in Fig. 6.

In these observations the breeding ewes showed a lower average and more extreme drops in serum magnesium levels from lambing in the second half of March until June. Fig. 7 shows the weekly changes in serum magnesium and calcium levels of a group of 2-year-old half-bred ewes, consisting of 4 non-breeding control sheep, 3 ewes with single lambs,

FIG. 4.--Average serum calcium and magnesium levels of Scotch blackface flock compared with two individual non-breeding sheep.



AVERAGE SERUM CALCIUM AND MAGNESIUM LEVELS OF SCOTCH BLACKFACE FLOCK COMPARED WITH TWO INDIVIDUAL SHEEP WITH TWIN LAMBS

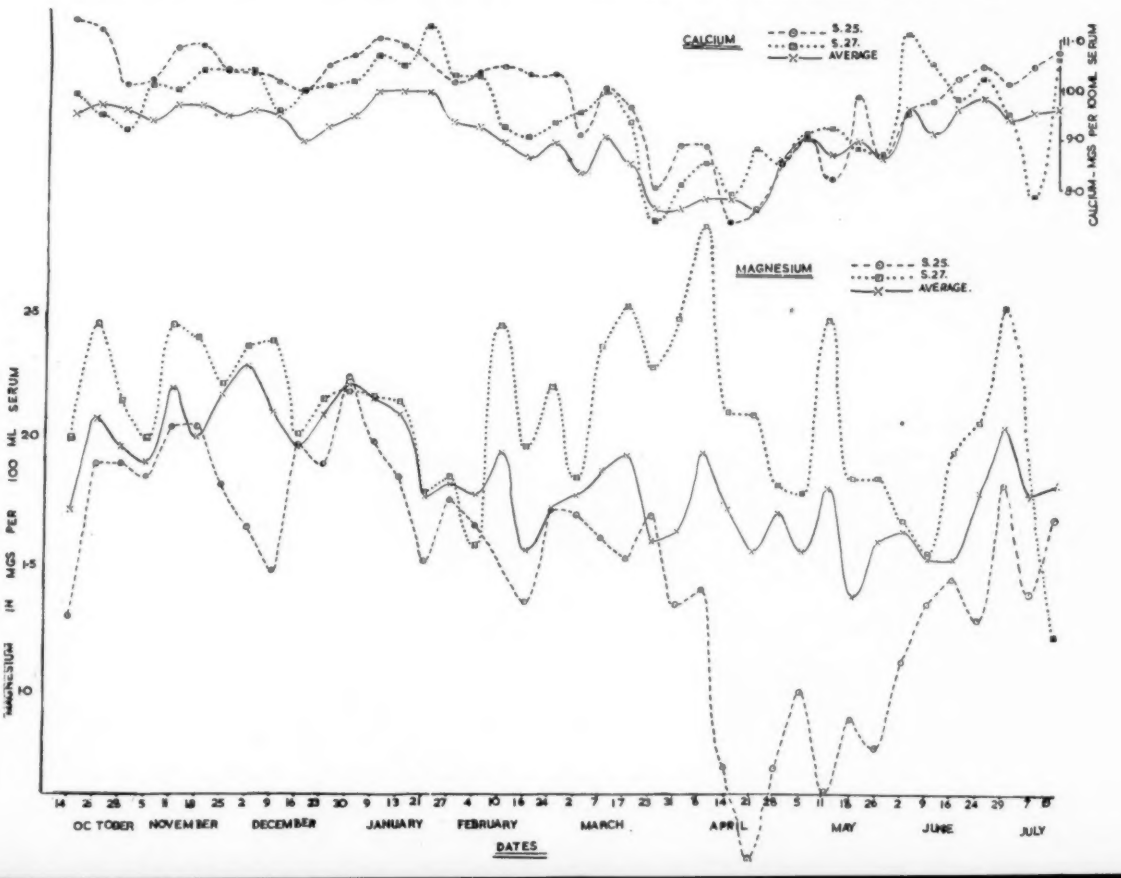
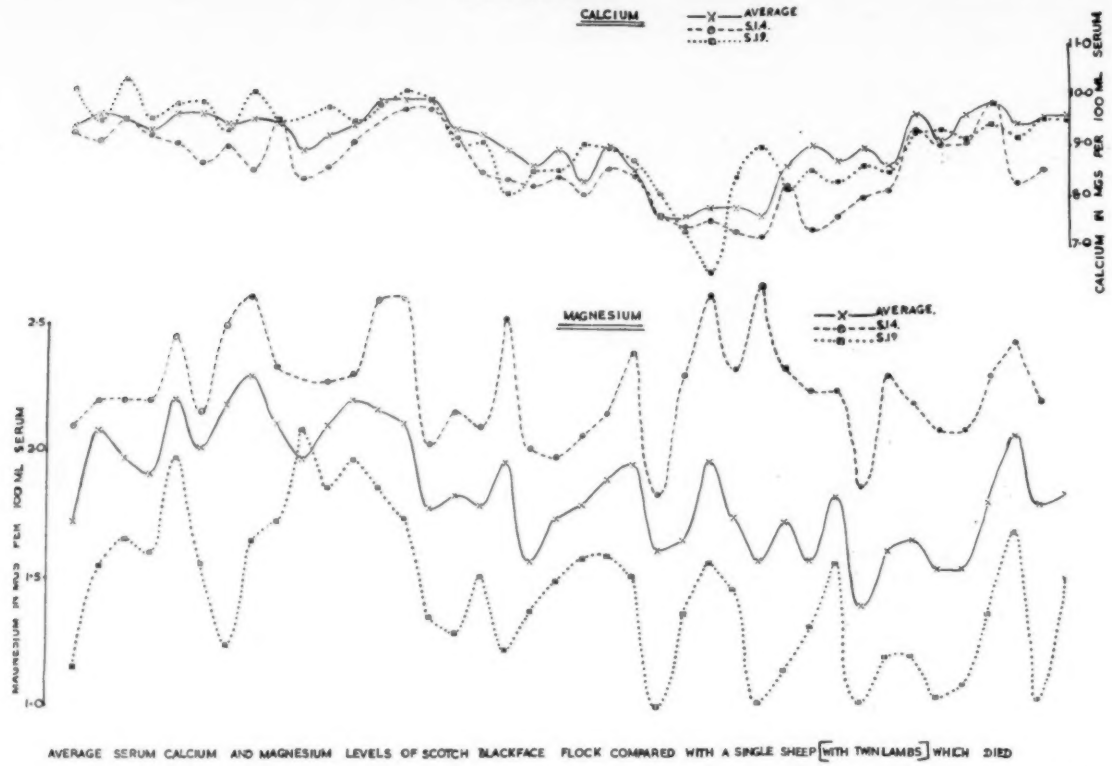
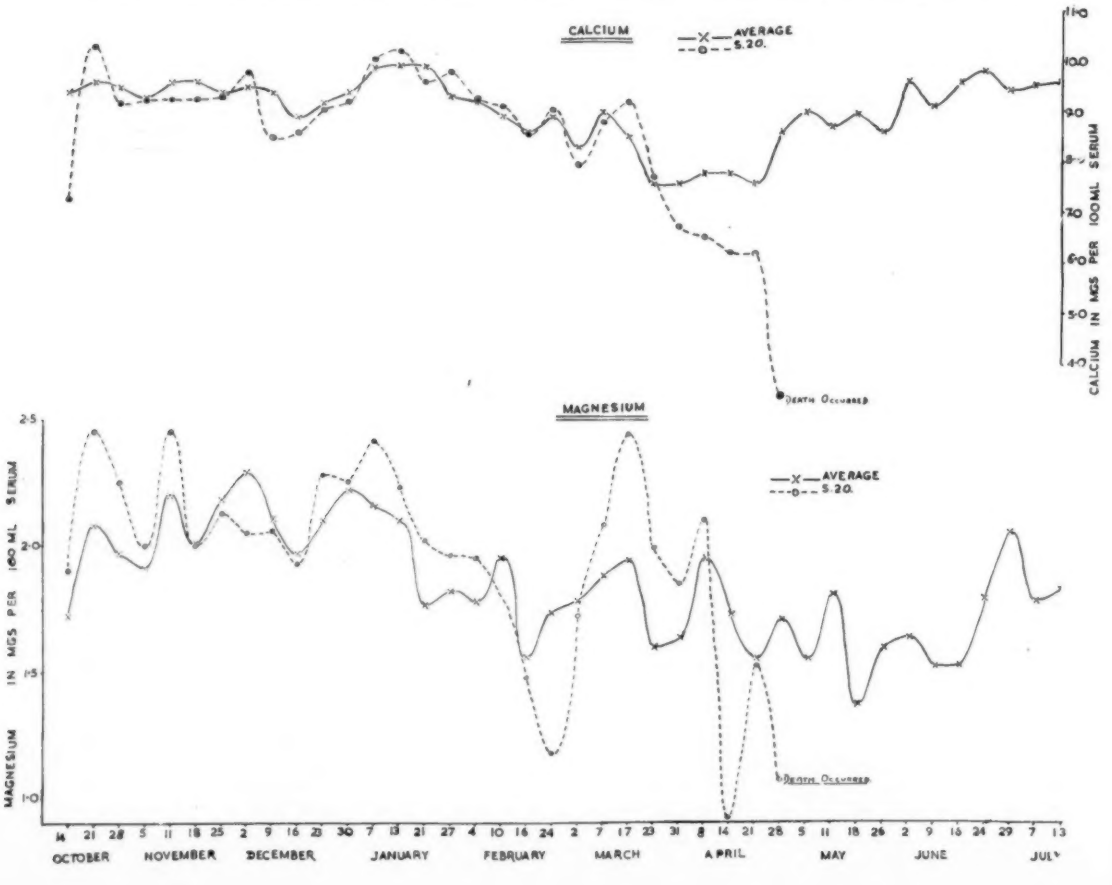


FIG. 5.—Average serum calcium and magnesium levels of Scotch blackface flock compared with two individual sheep with sing le lambs.



AVERAGE SERUM CALCIUM AND MAGNESIUM LEVELS OF SCOTCH BLACKFACE FLOCK COMPARED WITH A SINGLE SHEEP [WITH TWIN LAMBS] WHICH DIED



10 ewes with twin lambs and 2 ewes with triplets. All 4 categories of sheep followed much the same pattern in respect of serum magnesium levels, but the ewes with triplets had lower serum magnesium levels than the others from the time of lambing in the second half of March until May. The serum calcium behaved very similarly in each group, but the group carrying triplets showed a tendency to rather low levels from time to time during February and March.

Effect of Fasting.

Fig. 8 shows the effects of 4 days fasting on the serum magnesium levels of 4 pregnant and 3 non-pregnant young half-bred ewes over the period March 23rd to 27th. A significant drop in magnesium levels occurred in both categories. Feeding quickly restored the magnesium levels to normal. Similar results were found in other groups of fasting half-bred ewes. Figs. 9 and 10 show the serum magnesium levels of fasting groups of pregnant and non-pregnant sheep, compared with levels from normally fed pregnant ewes; each group consisted of 4 ewes. The fasting groups in Fig. 9 were fasted from February 26th to March 3rd. Similar sheep in Fig. 10 were fasted from March 14th to 21st, within a week of the lambing of the pregnant sheep. All groups of fasting sheep exhibited marked falls in average serum magnesium values compared with the control animals and recommencement of feeding restored the levels.

FIG. 6.—Average serum magnesium levels of breeding and non-breeding half-bred ewes.

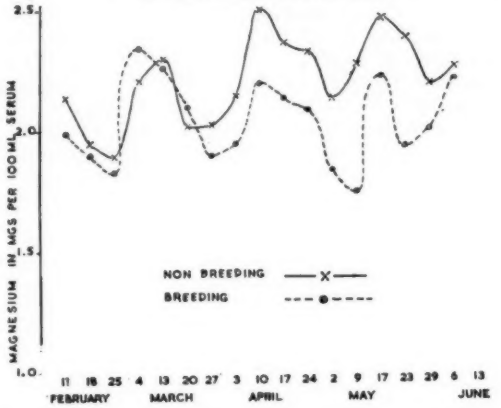


FIG. 7.—Average serum calcium and magnesium levels of non-breeding half-bred ewes, and half-bred ewes with single lambs, with twin lambs, and with triplets.

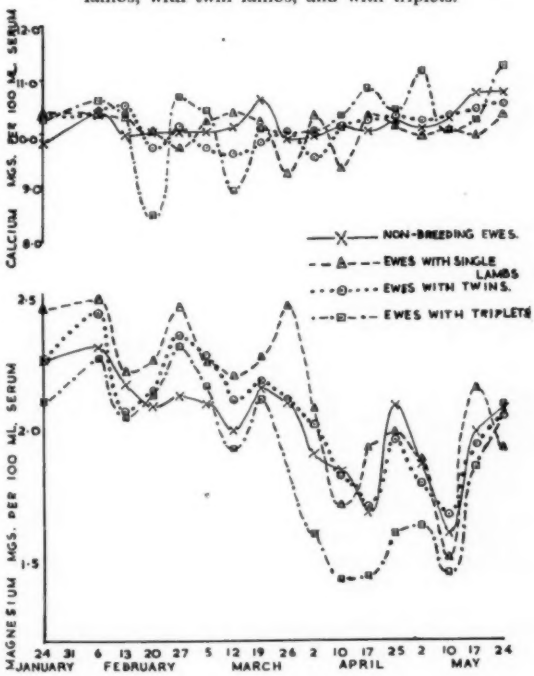


FIG. 8.—The effect of fasting on average serum magnesium levels of pregnant and non-pregnant half-bred ewes.

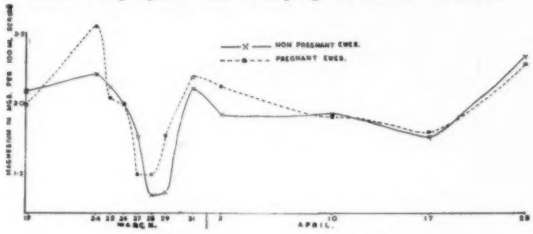
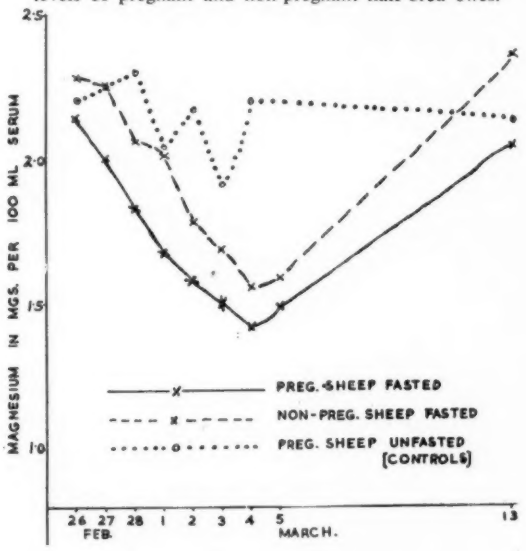


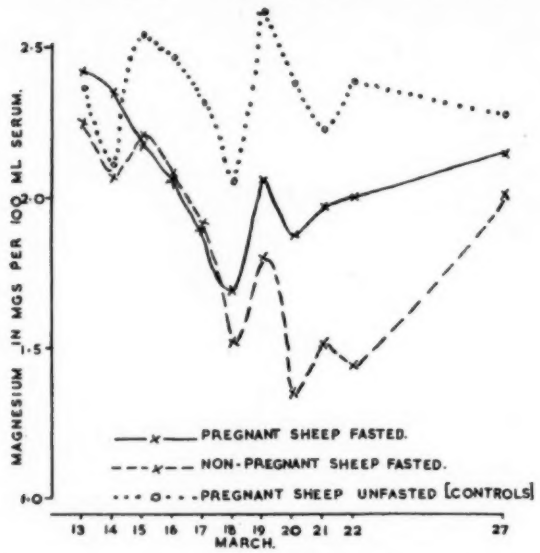
FIG. 9.—The effect of fasting on average serum magnesium levels of pregnant and non-pregnant half-bred ewes.



Effect of changes in Fibre, Protein and Magnesium of Herbage on Serum Magnesium.

Samples of herbage from the pasture grazed by the half-bred flock were analysed for fibre, crude protein and magnesium levels at weekly intervals from the middle of March until early June, 1957. These

FIG. 10.—The effect of fasting on average serum magnesium levels of pregnant and non-pregnant half-bred ewes.



results are depicted in Fig. 11 along with the weekly changes in average serum magnesium levels of the ewes. The lowest serum magnesium levels occurred on May 9th at a time when the herbage was still relatively low in fibre, although it had started to grow rapidly. Serum magnesium values rose to higher levels, although subject to considerable fluctuation, as the fibre content of the herbage increased in the second half of May. The crude protein in the herbage, with minor fluctuations, fell throughout this period. When the serum magnesium levels were low in May the herbage had commenced to grow rapidly and the protein content was still relatively high but it continued to fall as the average serum magnesium levels became higher in the second half of May and June.

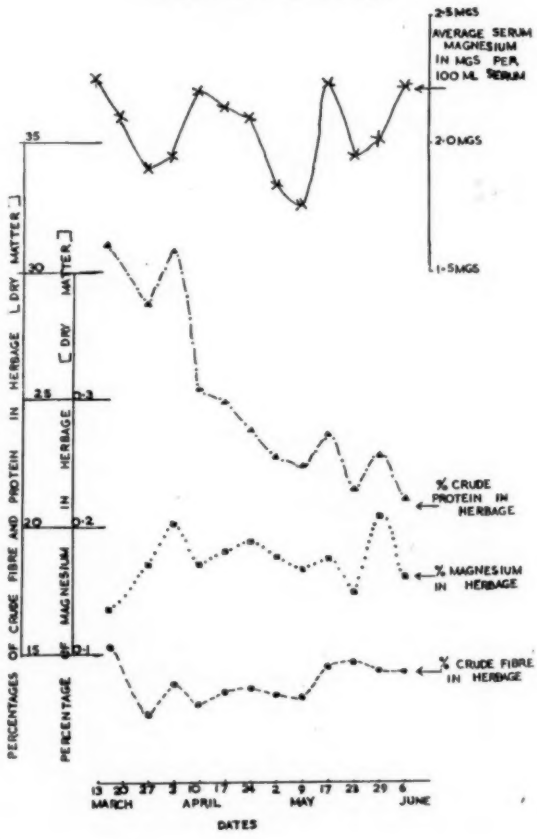
The magnesium content of the herbage dry matter dropped from its peak of 0.2 per cent. on April 3rd to 0.17 per cent. at the time of the low serum magnesium levels on May 9th. However, this fall does not necessarily explain the fall in serum magnesium values as the herbage greatly increased in quantity at the same time. On the whole the data show that changes in serum magnesium levels did not follow changes in magnesium in the herbage.

Discussion

The observations made on blood samples from field cases where hypomagnesaemic tetany was confirmed show that in a proportion of cases there is a hypocalcaemia in addition to a hypomagnesaemia and that in others there is no hypocalcaemia. Another point of interest was that the average serum magnesium level of a flock where deaths due to hypomagnesaemic tetany were occurring was of the same order as that in the experimental flocks at the time of their lowest average levels in May and June. The wide variation between the highest and lowest serum magnesium level in the flock where deaths were occurring indicated the importance of examining a number of samples when attempting to confirm hypomagnesaemic tetany.

Very few experimental studies have been carried out in relation to hypomagnesaemia in sheep and those which have been made in the past mostly concerned the effects of high potassium levels in the diet. This work was stimulated mainly as a result of the view of certain workers in the Netherlands that the most constant characteristic of pastures on which tetany in cattle occurs is a high potassium content. Results with diets containing high potassium levels have been variable, *e.g.* Pearson *et al.* (1949), Odell *et al.* (1952), Eaton *et al.* (1952) failed to change the magnesium levels significantly by feeding high levels of potassium to sheep. On the other hand Kunkel *et al.* (1953) depressed serum magnesium levels in sheep when they fed a ration rich in potassium, but they also noted that the food intake on the high potassium diet was diminished compared with the controls. In this connexion it is of interest that we observed a depression in serum magnesium levels during short periods of fasting.

FIG. 11.—Average serum magnesium levels in mg. per cent. of half-bred ewes and percentages of fibre, protein, and magnesium in the herbage.



The observations on average serum magnesium levels in the experimental flocks all emphasised the close relationship of climatic conditions to falls in serum magnesium levels, mild weather during or soon after periods of considerable rainfall in the early part of the growing season leading to the most serious types of depression. In each of the three years of our observations the lowest point in average magnesium levels occurred in May, but quite low levels were also encountered in April and even in March associated with mild growing weather. Cold weather, particularly if accompanied by snow, also appeared to produce a very considerable fall, this type of fall being encountered by us mainly in February. While fluctuations also took place in June, the general level was then higher and the low points did not reach the extreme low levels encountered earlier in the season. If reference is made to the confirmed cases of hypomagnesaemic tetany in Table I it will be seen that 8 out of 10 recorded occurred at a time very near the lowest points in Figs. 1, 2 and 3, while the other two occurred at times when no routine observations were being made. It would appear that average magnesium levels are low and the sheep are only at serious risk from hypomagnesaemic tetany during certain relatively short phases in late winter and spring.

With respect to changes in average serum calcium levels, while we did encounter a drop in the spring, the percentage fall was much less than in the case of serum magnesium and calcium levels did not fluctuate in close relationship to climatic variation as the magnesium levels appeared to do. There were no extreme low average levels of calcium in the month of May as was found in the case of magnesium.

The studies on individual variation indicated that while there is a general pattern of change of magnesium levels in sheep depending on climatic conditions, individuals show very considerable differences in general levels and in the extent of the fluctuations, certain individuals coming into the danger zone while others keep in a higher range. In respect of calcium, a tendency is also shown for certain individuals to depart from the general behaviour of the flock and show extreme low levels from time to time.

Our comparison of the serum magnesium levels of breeding and non-breeding sheep indicates that both groups show the same type of fluctuation and sheep in either category can show extremely low levels.

The fall in serum magnesium levels encountered during fasting suggests that the depression in magnesium levels which takes place in the field during periods of cold, severe weather when food is scarce may be explained by the starvation effect, although according to the findings of Hegsted *et al.* (1956) low temperature might well have an aggravating effect.

The attempts to correlate changing composition of the herbage with the changes in serum magnesium levels did not indicate that the magnesium content of the herbage was an important factor in the fall associated with rapidly growing herbage. However, the results did suggest the possibility of a correlation with the fibre and protein contents; the low serum magnesium levels appeared to correlate with low fibre and high protein.

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SEMINAR ON ANAEROBIC DISEASES

A Seminar on anaerobic diseases of cattle and sheep has been held at the Central Veterinary Laboratory, Weybridge, from October 8th to 23rd. It has been organised mainly for representatives of the Central Treaty Organisation countries, including Iran, Pakistan, Turkey, and is the third Seminar of its kind, under the Chairmanship of the Director, Dr. A. W. Stableforth. Observers from the United Kingdom and from the United States were present.

Demonstrators and Lecturers were provided by three pharmaceutical companies: Messrs. Burroughs Wellcome, Glaxo Laboratories, and The Evans Biological Institute, and those attending the Seminar were invited to visit the laboratories belonging to these firms.

THE REGISTER OF VETERINARY SURGEONS

The undermentioned gentlemen were admitted to membership on September 30th, 1959, in virtue of the registrable degree of B.V.Sc., of the University of Liverpool:—

EDWARDS, Marshall John, B.V.SC. (SYDNEY), University of Liverpool, Veterinary Field Station, Neston, Cheshire, October 14th, 1959.

STEPHEN, Lorne Edwin, D.V.M. (TORONTO), D.A.P. & E. (LONDON), West African Institute for Trypanosomiasis Research, Vom, Northern Nigeria, October 15th, 1959.

Skin Gangrene of the Bovine Udder

BY

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Salisbury

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Introduction

THE purpose of this paper is to draw attention to a disease characterised by gangrene of the skin of the bovine udder. The condition has been seen by the senior author in general practice in the Salisbury area over the past 20 years. In itself the disease is usually mild and the effect on the general health of the animal is minimal, but because of the location of the gangrene there is usually difficulty in milking and frequently the affected animal has to be dried off.

A description is given of the circumstances in which the disease occurs, of the clinical features, and of the pathological findings in two affected animals that were available for slaughter and *post-mortem* examination.

Occurrence

The disease occurs characteristically in newly-calved heifers with well developed udders showing a good deal of oedema. It has always been seen in the autumn when there was plenty of grass, usually after the first frosts have occurred. In some, but not all, instances the heifers have been "steamed up" prior to calving. The disease has been noted in animals of the Friesian, Ayrshire, and Shorthorn breeds. It tends to occur sporadically but has been seen 3 times on one farm and twice on another. The number of animals affected in a herd is usually small. In one instance, however, 15 out of 45 animals were involved and there was apparent spread from animal to animal; the secondary cases in this episode showed lesions that were much less severe than the primary cases, although the condition was still serious when the teat orifice was involved. In this particular herd the large proportion of affected animals, and the fact that no further cases occurred after rigid separation of affected from healthy animals, suggested the possibility that an infective agent was involved. Cultures from vesicle fluid in this instance yielded *Staphylococcus pyogenes*, but attempts at transmission using vesicle fluid, kindly undertaken by Mr. J. R. Hudson and Mr. R. A. Huck at Weybridge, by scarification of the skin of rabbits and the teats of maiden heifers were unsuccessful. It is realised that apparent limitation of spread of the disease in this herd by separation of affected from non-affected animals may have been fortuitous, but the observation is recorded as possibly having practical significance.

Clinical Features

Symptoms

The condition is first noticed at milking time because the heifer is fidgety and the teat is tender to touch. Within 24 hours the skin colour changes to purple, then to black, and the edges of the lesion are clearly defined. Closer observation shows that the first sign of abnormality is a vesicle containing straw-coloured fluid; this soon ruptures, coalesces with neighbouring vesicles, and produces an area of necrotic, then gangrenous skin. Vesicles tend to occur on hairless skin, especially the teats; over the hairy parts of the udder they are less obvious as the precursors of necrosis and gangrene.

The necrotic surface skin becomes hard and dry but does not appear to be painful except over the teats where the act of milking soon causes separation of the necrotic skin and exposure of raw, weeping tissue underneath. When a large portion of a teat is affected, particularly when the teat orifice is involved, there is great difficulty in milking because of pain caused to the cow. The site most usually affected is the base of the udder round the hind teats.

As the condition progresses the gangrenous tissue sloughs off to leave a healed or healing area underneath. The degree of sloughing and the extent of the healing process depend on the depth of the original necrosis, which is difficult to assess from the outset but may vary from paper thickness to the whole depth of the skin. The depth of necrosis is usually less at the periphery than at the centre of the lesion, and occasionally it is so deep that milk leaks from the underlying mammary tissue.

In the early stages of the disease the milk is normal, and any subsequent mastitis is the result of secondary infection. No systemic symptoms are observed unless there is secondary mastitis.

Prognosis

Prognosis depends on the site and severity of the lesions. The primary condition is, of itself, not serious, so that healing would be straightforward were it not for the necessity of milking. The extent of the gangrene seems to be fully determined within the first 24 hours, with no threat of subsequent spread. Complete healing takes from 1 to 4 months.

Secondary mastitis is frequently due to infection with *Corynebacterium pyogenes*.

Treatment

Because the disease sometimes gives the impression of being contagious, rigid hygiene with regard to milking should be observed. The affected teats are treated with antiseptic ointments in an animal fat base. Where the teat is extensively involved it may be advisable to consider inserting a large dose of antibiotic through the teat canal and then to stop milking. When the gangrenous skin has separated the unhealed area should be treated as an open wound. There seems to be little scope for using antihistamine drugs because the area of gangrene is already complete by the time the condition is first recognised.

Pathological Examination of Two Cases

Of the two animals available for *post-mortem* examination, one had been affected for about 6 weeks before slaughter and the other for about 2 weeks. The extent of the gangrene in this latter animal is shown in Fig. 1, and it will be noted that the left-fore teat was completely involved. In the animal affected for 6 weeks the lesions were healing and flakes of necrotic skin could be lifted to reveal fresh skin underneath. Because of difficulty in milking, both animals had been dried off and penicillin had been injected into all quarters. One quarter of one animal was clinically affected with mastitis.

FIG. 1.—Animal affected for 2 weeks. Note the area of gangrene, with complete involvement of the left-fore teat.

(1) *Macroscopic Appearance After Slaughter*

(a) *Animal affected for 6 weeks.* The superficial epidermal layers over a wide area of the ventral surface of the udder had sloughed, leaving a smooth,

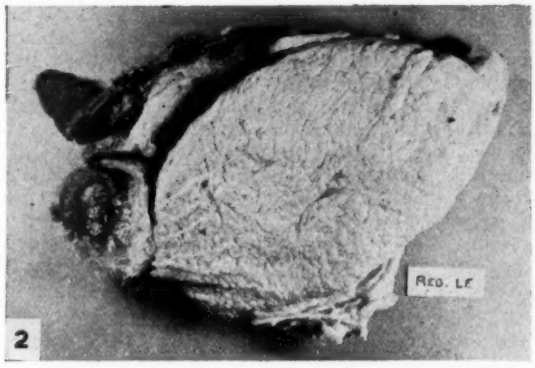

FIG. 2.—The left-fore quarter of the animal shown in Fig. 1. Note the limitation of gangrene to the skin, with no involvement of the mammary tissue.

clean, macroscopically normal skin surface underneath. In places, necrotic epidermal scales were still attached to the underlying tissue, particularly close to the median raphé. The skin of all teats was scaly, and recent sloughs were noted on two of them; there was no evidence of penetration of the lesions to the teat canal. Obvious mastitis was present in one quarter, of which the galactiferous sinus and large ducts were grossly dilated and filled with greenish, semi-fluid pus. *C. pyogenes* and *M. indolicus* were cultured from this quarter.

(b) *Animal affected for 2 weeks.* The skin of the entire ventral surface of the udder, extending posterodorsally to the perineum, was covered with separating scales of necrotic epidermis, brown to black in colour, with mascropically normal epidermis underneath. Three teats had annuli of necrotic, scaly epidermis at their bases, but the apices were not affected; bacteriological examination of this area was negative. The skin of the left-fore teat was black and dry (Figs. 1 and 2) and it had separated like a thimble from the underlying tissue. The surface of this underlying tissue was greyish, congested, and coated with greenish pus, from which *C. pyogenes*, *M. indolicus*, and a coagulase-negative staphylococcus were cultured. The necrosis did not appear to extend through the teat wall into the duct. The mammary tissue of all quarters was macroscopically normal.

(2) *Histological Examination*

Six blocks of tissue from each quarter of each animal, 3 blocks from each teat, and blocks from the liver were examined.

(a) *Animal affected for 6 weeks.* Tissue from the quarter that showed macroscopic evidence of

(*Concluded at foot of col. 1 overleaf*)

Gastro-enteritis in the Pig*

BY

A. R. JENNINGS

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THE digestive tract of the pig is subjected to many widely different forms of insult, both infectious and non-infectious, but since the ways in which tissues respond to injury are limited it follows that diagnosis of the clinico-pathological picture is often difficult. The term enteritis is defined as an inflammatory condition of the small intestine but it is a term which is often loosely applied to any pathological disturbance of the digestive tract of the pig. The use of the unqualified term enteritis is often confusing and may mean several different things to the clinician and to the pathologist. I propose to-day to try to classify the various forms of porcine digestive disturbance which occur; in doing so it is hoped that some general pattern may emerge and that the many obvious gaps in our knowledge will become more sharply defined.

The mucous membranes of the alimentary tract of animals react to adverse stimuli in the same general fashion, be the irritant a micro-organism or large foreign body. The phenomenon which is the common sequel to all such insults is inflammation and it is as well to remember when we see an inflamed intestine during a *post-mortem* examination that this is a non-specific reaction and is not diagnostic of any specific condition or disease. It is pertinent here to recollect one of the earliest definitions of inflammation—that given by John Hunter: "Inflammation in itself is not to be considered a disease but as a salutary operation consequent upon either some violence or some disease."

Inflammation is primarily a vascular phenomenon which starts in the capillaries. There is slowing of the blood stream, emigration of leucocytes, and exudation of the plasma through the vessel walls. The nature of the exudate depends upon the degree of damage to the vascular endothelium. This in turn is dependent upon the type of irritant and the length of its application to the tissues. In addition to these vascular changes there are constant and significant changes in the mucous glands. These glands are stimulated to secrete an excess of mucus and this excessive secretion of complex polysaccharides is one of the chief features of gastritis and enteritis. Relatively little is known about the control of mucus secretion. Experimentally it has been demonstrated that many mucous glands seem to be continually active and have the remarkable capacity to replenish the secretion as fast as it is removed.

The inflammatory process may involve the whole length of the digestive tract or it may be localised

* A paper presented to the meeting of the West of Scotland Division in Glasgow on February 4th, 1959.

Skin Gangrene of the Bovine Udder—*Concluded.*

mastitis was grossly abnormal, the inflammatory process being chronic and extensive. The other three quarters showed changes consistent with involution due to drying off, but no pathological abnormality. Examination of the teats showed patchy necrosis of the epidermal layer. There was a marked granulation tissue reaction underneath the areas of necrosis, and many areas showed development of a new surface layer of pavement epithelium. All the evidence indicated that this was a healing process without ulceration or permanent damage. The epithelium lining the teat ducts was normal. No significant abnormality was noted in the liver.

(b) *Animal affected for 2 weeks.* All mammary tissue examined showed early involution associated with drying off, but no pathological abnormality. Patchy but extensive epidermal necrosis was present on all teats, and in the case of the left-fore teat no normal skin was visible. There was a marked polymorph reaction on the damaged dermal surface to which shreds of necrotic debris adhered with granulation tissue in the deeper layers. In the teats less extensively involved there was evidence of healing and of formation of a new layer of pavement epithelium. The epithelium lining all teats was normal. No significant abnormality was noted in the liver.

The macroscopic and microscopic findings in these two cases indicated that pathological changes were limited to the epidermal layers of the skin of the udder and teats, and that after the skin had sloughed there was a rapid return to normality. The sites from which *C. pyogenes* was isolated indicated that this organism was a secondary invader; it was not considered to be a primary cause of the disease.

Discussion

These observations have not disclosed the aetiology of the disease, but the possibility of an infective agent being involved cannot be positively eliminated. The immediate cause of the gangrene is almost certainly interference with the blood circulation in the cutaneous vessels of the udder and teats, but whether this is due merely to physical interference with the blood supply or whether it follows some more subtle primary abnormality is not known. True photosensitisation appears to be unlikely, and it is possible that an unknown allergic factor is involved.

Acknowledgment.—We are most grateful to Mr. F. H. Summerfield, A.R.P.S., of Compton, for preparing the photographs.

to certain well-defined areas. The distribution of the lesion depends in large measure upon the greatest concentration of the irritant. This in turn depends upon a number of factors. The irritant, if a living agent, may be found in certain areas of the gut, *e.g. Clostridium welchii* type C in the ileum, or if the irritant be a toxic chemical, *e.g.* sodium fluoride, then the chief lesion will be in the stomach. Substances which are relatively insoluble may not exert their effect until they are well down the alimentary tract and physical agents such as an excess of fibre may produce their effect at the ileo-caecal region.

The complex termed gastro-enteritis results in both structural and functional changes. The cardinal clinical signs may be inappetence, vomiting, and diarrhoea. The immediate result of the loss of fluid and electrolyte is dehydration which results in serious changes throughout the body. The structural changes, or lesions, are those which result from the inflammatory reaction and several main types may be recognised. A knowledge of these types is of value in *post-mortem* diagnosis.

Catarrhal Gastro-enteritis

This type of gastro-enteritis is probably the most frequent one encountered since it represents the immediate reaction of the mucosa to injury. It is often followed by more severe changes. The chief distinguishing feature of this condition is the production of an excessive amount of mucus which covers the epithelial surface as a grey or yellowish-grey slimy material. This material is a mixture of mucus and desquamated epithelial cells. Beneath this catarrhal exudate the mucosa is hyperaemic and there may be a few petechial haemorrhages present. The mucosa is swollen and appears excessively moist.

Agents which Produce a Catarrhal Gastro-enteritis

Nutritional defects. In some nutritional disorders of the pig a catarrhal gastro-enteritis is a common finding and this produces a clinical syndrome of scouring and unthriftiness. Probably the most common nutritional disease is a microcytic hypochromic anaemia due to a lack of iron in the piglet's diet. Another condition in which there is a catarrhal gastro-enteritis is avitaminosis A.

Newly-born animals are very susceptible to sudden changes in the gut environment and it is probable that some at least of the so-called infectious scours of the piglet are due primarily to digestive disturbances and nutritional defects. Bacterial invasion of the devitalised gut mucosa probably occurs at a later stage. Changes in the management and especially in the diet of the very young piglet often precipitate attacks of diarrhoea. Young and Underdahl (1953) demonstrated that in colostrum-free piglets diarrhoea was easily induced by over-feeding.

Generally speaking in the very young animal the lesions are most marked in the stomach and small intestine, whereas it is the large gut which bears the brunt of the attack in the older pig. The fact that the first part of the alimentary canal should be so susceptible in the young animal is not surprising since for the 24 to 36 hours of life the gut has little, if any, digestive functions. The colostrum passes from the sow through the mucosa to the piglet's blood stream. Thus the very susceptible epithelial cells of the intestine are directly exposed to many of the hazards of the outside world.

It is very tempting to apply to the porcine diseases the findings of Blaxter and Wood (1953) who investigated diarrhoea in calves. These authors suggested that in calves scouring was associated with high intestinal tract failure and that bacteria play a secondary rôle by multiplying in the unabsorbed material present in the gut. From their experiments it appeared as if two sequelae were possible—if no immunity exists then bacterial multiplication occurs with tissue invasion and consequent disease, or if there is some immunity then organisms multiply and spread higher up the tract. The products of their metabolism are thus in part absorbed and in part diluted by a flow of electrolyte and water. There is thus brought about a great loss of electrolyte and water with consequent dehydration and not infrequently the death of the animal. In the very young piglet Beveridge (1959) suggested that the prime factor in many cases of diarrhoea may be too frequent suckling, which may cause food to pass from the stomach to the intestines before it has been sufficiently long exposed to gastric digestion.

Infectious agents. It is widely held that one of the most frequent causes of scours in piglets is *Escherichia coli*, which brings about a catarrhal enteritis. The clinical syndrome is of an acute disease characterised by a profuse watery diarrhoea which is usually yellowish-grey in colour. The piglet rapidly becomes comatose and death may occur within 42 to 72 hours. The disease may occur sporadically or in epidemic form and large numbers of successive litters may be lost. The sow and adult stock are not affected, a point of some significance in the differential diagnosis of this disease and infectious gastro-enteritis (transmissible gastro-enteritis). Broadly speaking there appear to be two syndromes of this disease. Firstly, there is the disease in piglets less than 1 week old. This is the acute septicaemic disease with many deaths in the litter. The second type of disease is seen in older pigs over the age of about 6 weeks. This syndrome has many of the features of an enterotoxaemia and merges into or overlaps the bowel oedema syndrome. Affected piglets usually respond to antibiotics but recovered piglets may receive a severe check and remain stunted. Gordon & Luke (1958) reported on the successful use of a vaccine against this disease. A killed vaccine prepared from strains of *E. coli* isolated from actual outbreaks was given to the pregnant sow. Two doses were recommended, the second about 10 days before farrowing.

Although there is a growing weight of circumstantial evidence which suggests that *E. coli* is closely associated with outbreaks of catarrhal enteritis, the disease has not yet, to my knowledge, been reproduced. It appears as if certain serotypes of the organism may be responsible for the disease and it is very probable that the key to the pathogenesis is to be found in a study of the gut environment along the lines carried out by Bullen and Battey (1957) on ovine enterotoxaemia. It should be recalled that

Bullen demonstrated that enterotoxaemia could not be reproduced in the sheep except by altering the conditions in the alimentary canal by sudden changes in the diet thereby producing a suitable substrate for bacterial multiplication.

Viral diseases sometimes cause scouring due to a catarrhal enteritis and some examples would include pig-pox, poliomyelitis suum, and enzootic pneumonia of pigs. In some outbreaks of these diseases the enteric signs may be the first to attract attention and, as pointed out by Goodwin (1957), it is often profitable to look elsewhere than in the intestine for the prime causes of enteritis. Lamont & Betts (1958), in a preliminary report, demonstrated the presence of entero-viruses in the alimentary tract of pigs—thus from the first 13 faeces samples examined 3 immunologically distinct cytopathogenic agents were recovered. It is not unlikely therefore that in the future some outbreaks of catarrhal enteritis will be shown to be due to entero-viruses. More recently Betts (unpublished) has recovered from 69 faeces samples 19 cytopathogenic agents.

In 1957 we (Goodwin & Jennings, 1958a) drew attention to a serious epidemic of gastro-enteritis of pigs in East Anglia. This disease is now known to occur elsewhere in Britain. Clinically the disease has a short incubation period and causes heavy mortality amongst new-born piglets. There is a profuse diarrhoea with occasional vomiting but rarely pyrexia. In the adult pig there is acute diarrhoea, usually grey-brown in colour, the liquid faeces may be squirted from the rectum like a jet of water from a hose. This diarrhoea has a most offensive odour. Many sows become affected just before or immediately after farrowing and agalactia was a common finding in such cases. The disease in fattening pigs and weaners resembled that in the adult stock. The mortality in these pigs was negligible but there was a very appreciable loss of weight and general body condition.

In the suckling pig the disease was much more severe and there was usually a high mortality. Diarrhoea, yellowish-green in colour, was a constant feature. The dominant factor in the piglet appeared to be the age at first infection. New-born piglets died within about 48 hours after first showing diarrhoea but piglets over about 10 days of age usually scoured for several days before death occurred. Piglets over 3 weeks of age showed severe diarrhoea but the mortality rate was very low.

The pathology of the disease together with detailed accounts of the epidemiology, the experimental transmission, and the relationship between this disease and the American transmissible gastro-enteritis have been described elsewhere (Goodwin & Jennings, 1959b, c). In the majority of cases the chief lesion is a catarrhal gastro-enteritis, but in about 25 per cent. of cases the enteritis is acute haemorrhagic in type and about 10 per cent. of cases show ulceration of the stomach. Frequently the only intestinal lesion at autopsy is a ballooning of the ileum with gas. Generally there is congestion of the mesenteric blood vessels and of the vessels of the meninges.

Birrell (1957) described outbreaks of a disease in pigs of various ages which was believed to be due to a vibrio organism. The chief clinical signs of the disease were diarrhoea and loss of condition. The lesions comprised a catarrhal inflammation of the small intestine and a reddening and a thickening of the caecum and colon. Much more work is required, however, before it can be established that vibriosis occurs in British pigs. It is known, however, that vibrios can be demonstrated in smears made from the intestinal mucosa of pigs with enteritis and in some cases the organism can be isolated in culture.

A number of parasites bring about a catarrhal gastro-enteritis. Thus the stomach worm *Hyostrongylus rubidus* causes an excessive secretion of mucus and eventually a thickening of the gastric mucosa. There may be pin-point haemorrhages and ulceration present. Less commonly, coccidiosis due to *E. debliecki* is sometimes a problem in young pigs. In this disease there is rarely the gross haemorrhage which is a feature of avian caecal coccidiosis. Intestinal ascariasis causes a catarrhal inflammation and the nematode *Oesophagostomum dentatum* produces similar changes together with characteristic nodule formation in the large gut. The pathogenicity of this last species is said to be doubtful but the inflammatory response which its presence initiates does not support this view. *Balantidium coli* is often present in the intestines of pigs in large numbers and may cause enteritis but its rôle as a pathogen is uncertain.

Haemorrhagic Gastro-enteritis

The lesions in acute haemorrhagic gastro-enteritis are due to a greatly increased permeability of the smaller blood vessels which result in the out-pouring of blood and plasma into the tissues and lumen of the gut. The digestive tract is acutely inflamed sometimes throughout its whole length or, if the causal agent has a predilection area, the changes may be localised. The gut contents may contain whole blood and this may appear in the faeces of the affected animal.

Three main groups of agents bring about haemorrhagic inflammation of the gut. These are firstly, certain bacteria, secondly, a number of chemical poisons, and finally, vascular accidents.

Anthrax

Infection of the pig with *B. anthracis* is classically described as producing an acute throat lesion with death from asphyxia. This view requires some modification. Porcine anthrax runs a subacute or even chronic course and is very often alimentary in origin. The majority of cases arise from the use of contaminated imported feeding-stuffs, especially bone and meat meal. The disease, when due to ingestion of the organisms in spore state, is often localised to the intestine where it produces a patchy but very acute haemorrhagic inflammation. The affected gut may be salmon pink in colour or rust coloured. The mucosa may be eroded and there is usually present a large amount of yellow ascitic fluid. The mesentery is thickened with a yellow, gelatinous material. This same material is often found around the kid-

neys. The mesenteric lymph nodes are enlarged, deep red in colour, and full of exudate. Some cases of anthrax in the pig present as an acute peritonitis. Not all strains of *B. anthracis* from the pig are typical in that the organisms may not be well encapsulated and consequently the diagnosis may depend entirely on cultural examinations. Saunders (1939) gave an excellent clinical description of the disease in the pig and although he stressed the intestinal nature of the disease he also commented upon the frequency of respiratory involvement. The two outstanding clinical signs of the disease according to Saunders were the high temperature and the dysentery.

Leptospirosis

Infection with *L. icterohaemorrhagiae* produces jaundice in suckling pigs. There is usually present an acute haemorrhagic enteritis with many haemorrhages on the serous and mucus coats of the gut as well as haemorrhages in other parts of the body. In some cases there may be no jaundice but only this picture of acute inflammation and extravasation of blood.

C. welchii Type C Infection

This disease, first described by Field and Gibson (1955), causes a heavy mortality in affected piglets in the first 72 hours of life. Piglets are strong at birth but soon become dull, apathetic, rapidly weaken, and die. A bloody diarrhoea is usually present in the terminal stages of the disease. The condition is an enterotoxaemia and follows the rapid multiplication of the organism in the jejunum. This part of the gut is acutely inflamed and is often distinct from the rest of the gut which appears to be normal. The affected intestine is deep red or violet in colour, the mucosa has a velvety appearance and the gut contents are pink or chocolate in colour due to the presence of blood. A reliable tentative diagnosis can often be made from a Gram-stained smear of the jejunal contents together with the clinical history and the *post-mortem* findings. Prophylactic treatment with the appropriate hyperimmune serum is very satisfactory.

Arsenical Poisoning

Various arsenical poisons are widely used on farms in the form of weed killers, grain dressings, insect poisons, dips, and wood preservatives and swine are not infrequently poisoned by these substances. Arsenical preparations are used for destroying potato tops and thus cases of poisoning may arise if pigs gain access to potato fields. Death may occur very quickly after ingestion of a fatal dose but usually all the signs of acute gastro-enteritis may be present before death. Haematuria as well as dysentery is a common clinical sign. The *post-mortem* lesions comprise an intense rose-red discoloration of the intestines and a very severe gastritis. There is extravasation of blood into the lumen of the intestine and the mucosa peels off very readily.

Sodium Fluoride Poisoning

This substance is still widely used as an anthelmintic and sometimes causes acute gastro-enteritis through accidental over-dosage. According to Garner (1957) concentrations as low as 4 to 5 per cent. are extremely toxic to pigs. The symptoms are those of any corrosive poisoning and the lesions are those of a per-acute haemorrhagic gastro-enteritis.

Derangements of the Gastro-intestinal Blood Supply

Interruption of the blood supply to the digestive tract is not uncommon in pigs over the age of 10 to 12 weeks. The usual causes of the vascular obstruction are torsion of the mesentery of the stomach, spleen, or intestine, or thrombosis of some branch of the mesenteric arterial plexus. The affected portion of the alimentary canal thus has its blood supply cut off and a whole series of changes is initiated. Essentially these changes comprise infarction with necrosis and gangrene of the affected area. Torsion of the mesentery occurs at the root and in some cases the twist may have corrected itself by the time the pig is examined *post mortem*. Some cases of torsion of the caecum have been encountered. In each of these cases the caecum contained large amounts of sandy, gritty material or small pebbles. The weight of this material was very considerable so that it was not difficult to conceive how partial obstruction and then torsion had arisen.

Frequently in these cases of acute vascular obstruction of the alimentary canal the pig may be found dead, no premonitory signs having been noted. In a few cases, however, such signs as restlessness, lying on the belly on the cold part of the pen, and constant stretching of the legs have been described.

Acute Haemorrhagic Gastro-enteritis of Unknown Origin

An apparently previously undescribed syndrome has been seen in store and adult pigs. The condition is not uncommon in East Anglia and is well recognised in other areas. The disease is characterised by sudden death of one or two pigs and the *post-mortem* picture is one of a per-acute haemorrhagic gastro-enteritis. Epidemic disease of this nature has not been encountered. The inflammation is most marked in the large gut but no part of the alimentary tract may be spared. The affected intestine is deep red in colour as is the mesentery and the adjacent lymph nodes. The gut lumen contains whole blood which may be quite unchanged. Petechiation on the epicardium and beneath the endocardium is a common finding. The peritoneal cavity contains a straw-coloured fluid and flakes of fibrin are present on the serous surfaces of the viscera.

All attempts to date to demonstrate a causal agent have failed. In many ways the disease resembles the condition termed Herztod except that the gross haemorrhage in the latter disease occurs in the myocardium instead of the gut. Many of these cases of acute haemorrhagic enteritis occur at a time when the pig has been subjected to various stress factors such as castration, inoculations of various vaccines, changes of diet, possibly movement to new houses, and so forth. In the same way stress appears to be a factor in Herztod in that the sudden death may

often be related to excitement at feeding time, movement from one area to another, and changes in the diet. The pig is an animal in which very rapid growth and rapid weight gains are the chief aims of the pig keeper and thus may be especially liable to stress effects. Ludvigsen (1953) considered that stress played an important part in the disease he termed muscular degeneration and, as he pointed out, this disease also bears a close resemblance to Herztod.

Frequently seen in both Herztod and acute haemorrhagic gastro-enteritis, are degenerative changes in the smaller arteries. A type of periarteritis nodosa is sometimes seen, in other cases there is a hyaline degeneration of the media; thrombosis of these affected vessels is also a common finding. It seems therefore probable that the pig is prone to arterial disease. In support of this, Obel (1953) described similar arterial changes in hepatosis dietetica and cited other workers who had noted vascular lesions in the pig. Done (1957) mentioned arteriolar haemorrhages in the brain associated with degenerative changes in the media.

It may well be, therefore, that the condition termed acute haemorrhagic gastro-enteritis is one part only of a disease complex, a major cause of this being various stress factors which bring about arterial disease and the end picture which is seen in the *post-mortem* room depends entirely upon which organ bears the brunt of the attack—the heart, the intestine, the brain, or the liver.

Fibrinous and Ulcerative Enteritis

Diphtheresis and ulceration of the mucosa usually occur together. In some cases the fibrinous deposit on the mucous surface may be slight and the underlying mucosa appears normal but on microscopical examination the necrosis is plainly visible. As with other forms of enteritis the extent and distribution of the lesions vary greatly. Most cases of ulcerative enteritis represent subacute or chronic disease and of the various infectious agents which produce ulceration it must be remembered that these causes may produce a more acute type of enteritis.

Swine Fever

In any discussion on ulceration of the porcine intestine swine fever must come first but equally well it could come first on the list of the other forms of enteritis already mentioned. The lesions of swine fever are protean. In some cases, particularly in the very young pig, only minimal lesions are shown and these are often non-specific. The classical button ulcers which constitute the reason for the inclusion of swine fever in this section are seen in only some cases of the disease. Thus Doyle (1933) stated that the frequency of intestinal ulceration varied in different outbreaks and that it occurred in about one-third of all pigs infected at the Central Veterinary Laboratory at Weybridge. Most workers agree that intestinal ulceration is more likely to occur in chronic cases.

Ulceration, when it occurs, is localised. The lesions are usually dry, crusty, and circular in appearance with an annular structure due to layers of necrotic tissue and fibrin. The colour of these ulcers varies, some are red but often they are greenish-black in colour, due to the presence of various iron sulphides. The number and distribution of the ulcers vary; usually they are multiple and occur most frequently around the ileo-caecal valve.

Before leaving the subject of the lesions of swine fever it is as well to recall the findings of Kernkamp (1939). He studied the frequency of the lesions in the organs and tissues of 334 pigs infected with swine fever and his findings were: the kidneys were involved in 92.5 per cent., the urinary bladder in 83.2 per cent., the lymph nodes in 83.5 per cent., the spleen in 60.2 per cent., and the larynx in 59.6 per cent. Intestinal lesions, however, were much less common, thus only 9.3 per cent. of cases had lesions in the small intestine and 24.6 per cent. lesions in the large gut.

Swine Erysipelas

In acute and subacute swine erysipelas there is usually a fibrinous gastro-enteritis although this lesion is usually omitted from the description of the disease in the text-books. The stomach is acutely congested and dark red in colour but may show diffuse diphtheresis. The mucosae of the caecum and colon are covered with a yellowish-green deposit beneath which occurs a shallow, irregular ulceration.

It is very likely that the disease exists on many farms in a low-grade form and may go unrecognised until there is a flare up and the typical acute form is encountered. That the organism can exist in the apparently normal pig was first shown by Van Es and McGrath (1942). They isolated *Erysipelothrix rhusiopathiae* from the intestine of 26 out of 66 healthy pigs and from the tonsils of 28 out of 58 swine. Earlier, Van Es and McGrath (1936), had summed up the situation in regard to swine erysipelas by saying, "certain unknown influences and factors may bring about invasion by the organism with, now and then, actual disease as a result." The position is as obscure to-day—20 years later—as it was when that statement was made.

Swine Paratyphoid

Swine paratyphoid is due to *Salmonella cholerae suis* and although the disease receives prominent mention in the literature, in practice it appears to be of little importance. Only very infrequently is the organism isolated from cases of enteritis in pigs. *S. cholerae suis* is sometimes recovered from cases of septicaemia in young pigs and often when there are no macroscopic lesions of enteritis.

Necrotic Enteritis

Necrotic enteritis is the most common form of chronic enteritis encountered in the store pig. It is almost certainly the terminal stage of several diseases or disease complexes both infectious and nutritional in origin. The lesion occurs in the caecum and the terminal portion of the ileum. It is an extensive one and presents as a greyish-yellow area of thickened and ridged mucosal surface covered by a layer of fibrinous and necrotic material. Entangled with the

exudate are particles of ingesta and the whole combine to give a most offensive odour. The corrugations of the mucosa resemble those seen in Johne's disease in the ox. One particular form of chronic enteritis is called regional or terminal ileitis. It has some superficial resemblance to Crohn's disease of man. Emsbo (1951) was the first to draw attention to terminal ileitis in the pig and the condition was recognised in England 2 years later (Field, Buntain & Jennings, 1953).

The terminal portion of the ileum is a predilection area for chronic inflammatory lesions and some of the reasons for this susceptibility are known. The *p*H of the first part of the porcine jejunum is 6.4, about the middle it is 6.7, whereas the *p*H of the terminal ileum is 7.2. In association with this rise in *p*H there is a corresponding rise in the bacterial flora. Thus the bacterial count of the ileum is 10,000 times that of the jejunum (Emsbo, 1951).

The terminal part of the small intestine is very rich in lymphoid tissue and this is very liable to become hyperplastic. Lymphoid hyperplasia and a natural obstruction of the gut lumen at the terminal ileum brings about a slowing of the movement of ingesta at this point. Further support for this concept of slow movement in this area of the gut was provided by Neimeier (1939), who used X-ray techniques, and by Emsbo (1951) and Nielson (1955) both of whom demonstrated muscular hypertrophy of the terminal ileum.

The changes which occur in the ileum may be grouped into those in which the chief pathological features occur in the mucous membrane and those in which there is very appreciable muscular hypertrophy. The affected intestine is thickened and rigid, the so-called "hose-pipe gut." Not infrequently in these cases of ileitis the immediate cause of death is acute peritonitis which results from rupture of the gut usually on the mesenteric aspect. In some cases there may be more than one perforation and a number of fistulae may be present in the wall of the ileum.

Conclusions

It may be seen from this brief review that many widely different causes may produce common clinico-pathological states. The reactions of the gastro-intestinal tract are limited but the gross appearance of the lesions may serve as a very useful guide. In general the upper portion of the gastro-intestinal tract of the piglet is more often attacked than the lower gut. In the store pig and the adult the converse is usually the case. Many diseases in the pig result in a chronic proliferative enteritis centred around the terminal ileum and diagnosis at this stage is very difficult.

Many causes of enteritis are yet to be discovered but it is unlikely that these will emerge by the use of orthodox bacteriological methods. It is probable that it is in the fields of physiology, chemical pathology, and of bacterial ecology that most progress will be made. Still too little is known of the normal gut flora, both bacterial and viral, and even less is known of the environmental factors within the digestive tract which may allow disease to start.

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"TRUSTS AND FOUNDATIONS"

Our attention has been drawn to what seems to be a very useful work of reference for research workers and others who may be seeking grants to assist their studies. It is described as a select guide to grant-making bodies operating in the United Kingdom and the Commonwealth overseas, and is compiled by Guy W. Keeling, B.A., formerly secretary of the Association of Special Libraries & Information Bureaux, and of The Library Association.

Readers are invited to co-operate by bringing to the notice of the compiler, c/o W. J. Bryce Ltd., 41, Museum Street, W.C.1, the names and addresses of Foundations, under whatever title, that might usefully be included. Especially wanted are grant-making bodies whose areas of benefaction are not closely localised.

THE RESEARCH DEFENCE SOCIETY

The twenty-eighth Stephen Paget Memorial Lecture entitled "The Inevitability of Science" will be delivered by Professor Sir Solly Zuckerman, C.B., F.R.S., on November 17th, at 5.30 p.m., in the Physiology Lecture Theatre, University College London, Gower Street, W.C.1. All members of the Society and their friends will be welcome. The Annual General Meeting of the Society will be held after the lecture.

News and Comment

LEVERHULME RESEARCH AWARDS

Application is invited for Fellowships and grants in aid of research. These awards are intended for senior workers of established position and are limited to British-born subjects normally resident in the United Kingdom; in exceptional circumstances the Trustees may waive the condition as to residence. No subject of enquiry is excluded from consideration but preference is given to subjects in which existing provision for research is inadequate.

The duration of the awards does not extend over more than 2 years or less than 3 months, and the amount depends on the nature of the research and the circumstances of the applicant. Application must be made on Form "F" obtainable, together with further details, from the Secretary, Leverhulme Research Awards, St. Bridget's House, Bridewell Place, London, E.C.4.

The closing date is December 31st, 1959. Results will be announced in May and the awards will normally date from September 1st, 1960.

ROYAL SOCIETY OF HEALTH CONGRESS

Mr. Herbert Morrison will be the President of the Royal Society of Health's annual Congress to be held at Torquay from April 25th to 29th of next year. Sir Weldon Dalrymple-Champneys, Bt., will be the President of the Veterinary Hygiene section at the Congress.

KEITH ENTWISTLE MEMORIAL FUND

Dr. R. A. Green, Senior Treasurer, C.U.V.S., writes:—

The Cambridge University Veterinary Society, supported by the teaching staff of the Veterinary School and of the Sub-Department of Veterinary Anatomy, propose to establish a Fund to perpetuate the memory of Keith Entwistle.

The Society has decided that the most appropriate use to which to put this Fund is to hold annually an open lecture entitled "The Keith Entwistle Memorial Lecture" to be given by an invited speaker of distinction.

The Fund will be utilised to pay the lecturers' fee and subsistence.

If the sum collected proves to be sufficient, these annual charges upon it can be met from interest accruing. If it falls short of this, the C.U.V.S. will maintain it at its original figure by contributions from its general funds. As the Society is only a small one, the second alternative will tax its resources each year. That the Society has reached this unanimous decision is some measure of the regard in which they hold Keith Entwistle. He was the most promising Cambridge veterinary graduate since courses began in 1949 and for him to die within a few weeks of his graduation, with the beginnings of what may well have been a brilliant research career already arranged, was a tragic loss to Cambridge and to the veterinary profession.

All who knew Keith are asked to give generously. Contributions should be sent to the C.U.V.S., care of the Sub-Department of Veterinary Anatomy, Tennis Court Road, Cambridge, and marked "Keith Entwistle Memorial Fund." Cheques should be made payable to "the Cambridge University Veterinary Society Memorial Fund."

MR. R. P. JONES

J. R. H. writes from Bangkok:—

Robert Percy Jones was born on July 12th, 1888, at Stockport. He graduated at Liverpool in July, 1909, and, after a period spent as an assistant in a N. Wales practice, went to S. Africa where for a time he was a colleague of Mr. T. M. Doyle. During the First World War he joined the South Africa Veterinary Corps and saw service in Tanganyika, rising to the rank of Captain.

In 1923 he came out to Thailand and became veterinary adviser to the Department of Livestock Development, a post which he held until his death on October 7th, 1959. During the war he was interned with other British nationals in Bangkok.

Throughout his long service in Thailand "R.P.," as he was known to his friends, worked hard to improve the disease position and to develop the livestock industry. The results of his efforts are clearly to be seen. He was largely responsible for planning the campaign which led to the eradication of rinderpest in 1949. He was well-known in Hong Kong, Malaya, and Singapore through his efforts to arrange the export of livestock to these countries to improve their meat supply. He was associated with the Veterinary School in Bangkok where, even on Sundays and holidays, he directed the clinic until 10 a.m.

Although living for so long in the Far East, "R.P." never allowed himself to lose contact with the progress made in veterinary medicine in other countries. Copies of journals were always on his desk and often in the arm-chairs in his house. He kept himself very up to date both in the field of work of the Department of Livestock Development and in methods of treatment used in the small-animal clinic at the School.

Like all veterinary surgeons of his generation he was keenly interested in horses, and did much to help the development of horse-racing and polo in Bangkok. At the time of his death he still had a few ponies on his farm at Pak Chong.

"R.P." was greatly loved and respected by his Thai colleagues, young and old; in fact most of them regarded him as their teacher and second "father." He was honoured on many occasions by the King of Thailand, his last decoration being that of Knight Grand Cross (First Class) of the Most Noble Order of the Crown of Thailand.

To those of us Englishmen who had the privilege of his friendship he was one of the kindest and gentlest of men, and together with his Thai friends and colleagues we mourn his loss.

MR. J. A. MATHESON

J. D., N. S., and W. G. J. write:—

The death of John Allan Matheson has been a severe blow to all who were associated with him both

inside and without the profession. A man of fine appearance, and finer personality, he will be remembered by all who ever came in contact with him for his kindness, his generosity, and his thoughtfulness for others. He was a great lover of children; and his respect and help for the aged and infirm were constant reminders of the compassion and humanity that were such essential parts of his being.

The advancement of veterinary science, and the prestige of the veterinary profession, were always in the front of his mind: and by his outstanding clinical ability, and his personal example, he enhanced the status of the veterinary surgeon in no small way. With his passing we have lost one of nature's gentlemen.

PERSONAL

Mr. F. Lofthouse has just been unanimously elected chairman of the Advisory Committee of the Burley-in-Wharfedale Cattle Breeding Centre.

Births

ANDREW.—On October 9th, to Sheila (*née* Bateman), wife of Angus S. Andrew, M.R.C.V.S., a daughter, Celia Kay, sister for Ian and Stuart. Address: 251, Wellington Road North, Heaton Chapel, Stockport.

WATSON.—On October 11th, 1959, to Wilma, wife of William A. Watson, B.V.SC., M.R.C.V.S., The Maples, Otley, Yorks, a daughter, Sylvia Wilma.

COMING EVENTS

October

27th (Tues.). Meeting of the Society for the Study of Animal Breeding at the Royal Society of Medicine, 1, Wimpole Street, London, W.1, 11.30 a.m.

Meeting of the Society for the Study of Animal Breeding at the Royal Society of Medicine, 1, Wimpole Street, London, W.1, 11.30 a.m.

28th (Wed.). Meeting of the Dumfries and Galloway Division, at the Ernespie Hotel, Castle Douglas, 2.15 p.m.

General Meeting of the Sussex Veterinary Society at the Old Ship Hotel, Brighton, 2.30 p.m.

29th (Thurs.). Meeting of the R.A.V.C. Division at the Home of Rest for Horses, Boreham Wood, Herts., 11 a.m.

30th (Fri.). Meeting of the A.V.T. & R.W. Southern Region at the Royal Veterinary College, Camden Town, N.W.1, 2.30 p.m.

Meeting of the Yorkshire Division at Parkway Hotel, Bramhope, Leeds. (*N.B.* change of venue.)

Autumn General Meeting of the North of England Veterinary Medical Association in the Physics Theatre, King's College, Newcastle upon Tyne, 7 p.m.

Autumn Meeting of the Eastern Counties Veterinary Society at the George Hotel, Colchester, 11.30 a.m.

November

4th (Wed.). Fourth Annual General Meeting of the R.V.C. Association at the Royal Veterinary College, London, N.W.1, 5.30 p.m.

11th (Wed.). General Meeting of the Lancashire Veterinary Association at Liverpool, 2.30 p.m.

13th (Fri.). Annual General Meeting of the North Wales Division at the Gwydyr Hotel, Bettws-y-Coed, 2 p.m.

22nd Commemoration Ball of the Royal Veterinary College in the Great Hall, 8 p.m.

18th (Wed.). Meeting of the Scottish Metropolitan Division in the Royal (Dick) School of Veterinary Studies, Edinburgh, 2.30 p.m.

19th (Thurs.). Annual Dinner-Dance of the V.V.B.F. Northern Region in the Northern Hotel, Aberdeen, 7.30 p.m.

Dinner-Dance of the Lakeland Veterinary Association at the Hydro Hotel, Windermere, 7.30 p.m.

20th (Fri.). Dinner-Dance of the V.V.B.F. Ladies' Guild, Dumfries and Galloway Division, in Lockerbie House Hotel.

26th (Thurs.). Meeting of the B.V.A. Overseas Committee at 7, Mansfield Street, London, W.1, 11 a.m.

28th (Sat.). Meeting of the Metropolitan Region of the B.S.A.V.A. at 1, Wimpole Street, London, W.1; dinner 7 p.m. for 7.30 p.m.; paper 9 p.m.

B.V.A. COMMITTEE AND COUNCIL MEETINGS IN LONDON

Tuesday, November 3rd—at 7, Mansfield Street
5.00 p.m. Finance Sub-Committee.

Wednesday, November 4th—at 7, Mansfield Street
10.00 a.m. Parliamentary and Public Relations Committee.
11.30 a.m. Farm Livestock Committee.
2.15 p.m. Small Animals Committee.

Thursday, November 5th—at 7, Mansfield Street
10.00 a.m. Veterinary State Medicine Committee.
11.30 a.m. Home Appointments Committee.
2.30 p.m. General Purposes and Finance Committee.

Friday, November 6th—at Connaught Rooms, Great Queen Street, London, W.C.2
10.15 a.m. Council Meeting.

ADDRESSES OF DISEASE INFECTED PREMISES

The list given below indicates, first the county in which are situated the premises on which disease has been confirmed, followed by the postal address and date of outbreak.

Anthrax

Sussex. Northwood Farm, West Hoathley, East Grinstead (Oct. 13).
Wilts. Stowford Manor Farm, Wingfield, Trowbridge; Oxstall Farm, Wingfield, Trowbridge (Oct. 13).
Yorks. Hill Farm, Gowdall, Snaith, Goole (Oct. 15).

Atrophic Rhinitis

Dorset. Westholme Farm, Wareham (Oct. 14).

Letters to the Editor

The views expressed in letters addressed to the Editor represent the personal opinions of the writer only and their publication does not imply endorsement by the B.V.A.

SCIENTIFIC

The Use of Succinyl Choline Chloride as a Casting Agent in the Horse

Sir,—In this Department detailed observations have been made on the use of succinyl choline chloride as a casting agent in 28 horses to date. The observations recorded here agree very closely with those published by Neal and Wright in THE VETERINARY RECORD of October 17th, 1959.

It is indeed strange that the authors of previous articles on this subject have failed to point out the great increase in heart rate that follows the intravenous use of this drug. In America, Belling and Booth (1955) in detailed observations on the use of this drug state that the slight to moderate increases and/or decreases in heart rate were not consistent and at no time were they considered important. In fact Hansson (1956) states that the only complication of importance is respiratory arrest resulting from over-dosage. Stowe (1955) makes no mention of an increase in heart rate but mentions striking electrocardiographic changes in cases of over-dosage. In the series of cases that have been observed in this Department, a marked tachycardia has been noted in 20 horses. Marked arrythmias have also been noted, but no cases of bradycardia have been observed.

One fatality has been recorded. This was a 22-year-old riding horse gelding of 8½ cwt. liveweight. The horse died from primary cardiac arrest 2½ minutes after the intravenous injection of 85 mg. of succinyl choline chloride. The heart rate rose from 28 per minute at rest to 188 per minute, 90 seconds after the injection. At 2½ minutes the heart could not be heard with a stethoscope and artificial respirations were commenced, although spontaneous respirations were still observed until 5 minutes after the injection. There was no period of apnoea and spasmodic movements of the limbs had been observed during the first 2½ minutes following the injection. *Post-mortem* examination showed a marked fatty change to be present in the heart.

In one other case of an aged Pony gelding of 7 cwt. live-weight the heart stopped beating 3 minutes after the intravenous injection of 70 mg. of succinyl choline chloride. The heart recommenced beating after a period of 90 seconds during which time artificial respirations had been applied. Spontaneous respirations had never ceased during this time, however, and the horse made a normal recovery.

In South Africa, Lock and Harthoorn (1959) have noted a fatality in the Zebra where despite the application of adequate artificial respiration, the heart suddenly slowed and stopped following the intramuscular use of succinyl choline chloride. In Australia, Larsen *et al.* (1959) report detailed observations on cardio-vascular damage occurring in the horse following the intravenous injection of this drug and also record a marked increase in heart rate. There would appear to be reports by trainers in Australia of loss in racing form by horses, following castration under this drug.

From these observations and reports it is very obvious that great consideration must be paid to the cardio-vascular system of a horse which is to be subjected to treatment with this drug. With these considerations in mind, detailed observations are being made in this Department on the use of suitable premedicant agents in an attempt to control the undesirable effects of this drug. There is, however, much experimental work still in hand which must be completed before definite conclusions can be reached. In Sweden, Hansson (1956, 1957) reports the intravenous use of a 6 per cent. solution of pentobarbitone sodium as a routine premedicant agent.

There have been certain occasions when the use of this drug as a casting agent has been extremely useful. In particular, the casting of 2 horses with fractured limbs, where the application of hobbles or sidelines has been impracticable; and in circumstances where it is necessary to cast a horse in a confined space this drug can prove to be very valuable.

More detailed observations on the use of succinyl choline chloride over the past 18 months will be published at no distant date, but it was felt opportune at this time to support the findings of Neal and Wright.

Yours faithfully,

W. D. TAVERNOR.

Department of Surgery,
Royal Veterinary College,
Hawkshead Lane,
North Mimms,
Hatfield, Herts.

October 20th, 1959.

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Simultaneous Inoculation Against Distemper and C.V.H.

Sir,—In a recent letter (*Vet. Rec.* **71.** 333), it was reported that the simultaneous inoculation of 9-week-old puppies against canine distemper and canine virus hepatitis resulted in satisfactory antibody stimulation to both vaccines with no interference. The serum neutralising antibody titres 28 days after completing vaccination with an egg-adapted living distemper virus, an inactivated hepatitis virus, or both vaccines simultaneously were tabulated.

Studies were made on 2 further groups of 9-week-old puppies to assess the development of neutralising antibodies to canine distemper virus and canine

hepatitis virus and of agglutinin antibodies to *Leptospira canicola* and *Leptospira icterohaemorrhagiae*.

Group 1 was inoculated with a combined canine leptospirosis vaccine consisting of a liquid suspension of killed virulent strains of *L. icterohaemorrhagiae* and *L. canicola* with a second similar inoculation in 14 days.

Group 2 was inoculated with the combined canine leptospirosis vaccine* as used in Group 1, together with egg-adapted living distemper virus† and inactivated hepatitis virus,‡ with a second injection of the combined leptospirosis vaccine and inactivated hepatitis virus in 14 days.

The results are summarised in the following Table:—

Dog No.	Vaccine	28 days after commencement of vaccination			
		Titre of serum neutralising antibody		Titre of agglutinin antibody	
		C.D.V.	C.H.V.	*L. can.*	*L. ict.*
59	Combined leptospirosis	0	0	1:30	1:300
133	" "	0	0	1:30	1:300
97	" "	0	0	1:100	1:100
121	" "	0	0	1:300	1:100
146	" "	0	0	1:100	1:100
143	Combined leptospirosis + distemper + hepatitis	1:320	1:160	1:30	1:30
144	" "	1:80	1:80	1:100	1:100
145	" "	1:80	1:160	1:300	1:300

It will be seen that there is no antagonism between the 3 vaccines in their effect on antibody development.

Yours faithfully,
R. E. ABLETT,
O. UVAROV,
I. E. ADDISON,
L. A. BAKER.

Glaxo Laboratories Ltd.,
Greenford, Middlesex.
October 12th, 1959.

* Lepsolin. † Canilin-D. ‡ Canilin-H.

Bone Pinning in a Toque Monkey (*M. sinica*)

Sir,—In reply to Miss Fardell's request for information concerning bone pinning in monkeys, I enclose some notes on the one case with which I have been concerned.

The animal was a young adult female Toque monkey (*Macaca sinica*) in the Royal Zoological Society of Scotland's collection at Edinburgh, which sustained a complete fracture of the shaft of the right humerus. The animal was very young and showed little evidence of pain when padded splints were bandaged in place. It removed them in a very short time, however, when returned to its cage and the whole procedure was repeated with the same result. On the next day a light plaster cast was applied which the monkey obviously disliked and managed to remove by the next morning. As it showed little sign of distress no treatment was given for 14 days. On examination, the ends of the bone were not in contact, little callus formation had taken place and it was decided to attempt pinning.

Three pins of different lengths were prepared from heavy stainless steel wire. Open reduction of the fracture was carried out under pentobarbital sodium anaesthesia (0.75 g. approx. intravenously). The selected pin was inserted through the skin into the greater tuberosity of the humerus and guided into the distal portion of the bone *via* the operation wound. There was a great deal of trauma and despite suturing of muscle some dead space remained. Antibiotics were given by injection on the 1st, 2nd and 4th days and use of the arm began to return about the 7th day. Calcium phosphate was given daily in food and a vitamin D injection on the 11th day. Fourteen days after the operation little callus formation could be felt and deep nylon sutures continued to work to the surface after more than 3 months had passed.

The monkey lived actively for 2½ years, dying in January, 1957, apparently from acute streptococcal septicaemia. *Post-mortem* examination showed neat healing of the bone with little displacement and the pin still in position.

That success was achieved in this case was more by good luck than by good management. Pentobarbital sodium is not ideal in monkeys as an intravenous anaesthetic; my technique was unpractised and facilities were not of a high standard. The tameness of the animal, which reduced the shock of repeated handling, and the remarkable power of monkey tissue to heal rapidly and without sepsis were the factors of success. That the monkey was macaque and thus a rather more robust animal than the Green Monkey treated by Miss Fardell is probably not a factor of great importance.

Yours faithfully,
E. C. APPLEBY.

Royal Veterinary College,
Department of Pathology,
Royal College Street,
Camden Town, N.W.1.
October 12th, 1959.

The Colonial Veterinary Service

Sir,—May I endorse the remarks of Mr. Earnshaw with regard to Mr. Marshall's article? Very few recruits would be needed were the Service able to retain its members. Veterinary officers do not leave because of a lack of "pioneering spirit," though they may leave owing to being "fussy."

In Western Nigeria I became "fussy" over the following points. (a) At the last salary revision, my salary, from being slightly higher than the district officer's, became slightly under £400 less p.a. His responsibilities had meantime decreased greatly! (b) After a hard-fought rearguard action, I was *ordered* to pay £1 and have my name entered on a local register along with virtually unqualified persons. (c) The affairs of the Department were very much ordered by the Permanent Secretary of our Ministry (an Administrative Officer, salary £2,400 p.a.—more than the Chief Veterinary Officer was paid), with pitiful results. Apart from the sort of nonsense that arises in these circumstances, Parkinson's Law operated to the full, and from having spent most of my time on field work, I found towards the end of my time in Africa, that more than half was being taken up by office work. (At that, I worked con-

siderably longer hours than the official ones).

Mr. Marshall's suggestion that 10 years would be a suitable length of contract shows how out of touch senior officers can get. One can do a couple of tours in West Africa, and return to general practice without difficulty. One certainly could not do 10 years and hope to be in touch. It might prove impossible to find anyone willing to employ one! Still, one would have amassed the magnificent gratuity of £1,500 by that time. Contract officers can truly be described as "dirt cheap." They cost the employing Government even less than permanent service veterinary officers, and are treated like dirt.

Somewhere along the line, the Colonial veterinary Officer (in West Africa at any rate) has been let down. He can put up with malaria, a stinking climate, the endless stupidities of his staff and the endless obstructions of those whom he is trying to help, *but* he is getting tired of being "Billy Muggins," and he is leaving.

Perhaps we *have* been over-fussy, whether we graduated before or after the war. Perhaps Mr. Marshall was not fussy enough a few years ago.

Yours faithfully,
C. D. COOKE.

Church House,
Pontesbury, Salop.
October 9th, 1959.

Intussusception in a *Chinchilla lanigera*

Sir,—I read with interest Mr. Birkett's communication (THE VETERINARY RECORD, October 17th) since I also had occasion to operate on a chinchilla. The subject was 20 months old and pregnant for the second time. Parturition was 3 days overdue, based on a gestation period of 111 days. The owner's attention was drawn to its dejected appearance and inappetence.

The foetus was identified by abdominal palpation lying in a transverse position. Examination *per vagina* revealed a dilated cervix with partial protrusion of the limbs of a dehydrated foetus. The animal's temperature was 99.5°, and its condition was one of advancing toxaemia. Surgical interference was advised as the only practical course to adopt, and a very guarded prognosis was given.

Anaesthesia was induced using ether and oxygen delivered through a small mask. The uterus was approached through a mid-line incision and, after partial exteriorisation, was packed with swabs prior to making an incision in the body for the removal of the dead foetus and placenta. The induction of anaesthesia was stopped shortly after opening the uterus owing to the onset of shallow respiration. However, a state of anaesthesia persisted until after the completion of the operation. Intramammary penicillin was instilled into the uterus prior to closure with 3/0 catgut, using a continuous Lembert suture. The peritoneum and abdominal muscles were approximated with braided nylon interrupted sutures; the skin with braided nylon mattress sutures. 150,000 units of penicillin were administered intramuscularly. The animal was kept warm and returned to its owner on the following day. Recovery was uneventful and the skin sutures were removed on the seventh day.

Recovery under these circumstances suggests that the chinchilla possesses a vitality that should make for encouraging results when surgical treatment is contemplated.

Yours faithfully,
G. G. RHAM.

Shelley House,
Bishopric,
Horsham.
October 19th, 1959.

Sir,—Since you published our short article on "Intussusception in a Chinchilla," we have encountered a number of such cases, most of which have been successfully reduced.

We are still very uncertain as to the cause of this apparently common condition, as so far our cases do not appear to have any relation one to another and have occurred in quite young animals which were home-bred and had certainly not been subjected to any unaccustomed stresses or strains.

We have found inhalation anaesthesia safer and more satisfactory than barbiturates. This, it seems, is best administered under a bell-jar or, as we do it, in an R.S.P.C.A. cat lethal chamber. As soon as anaesthesia is complete, the animal is restrained with thin strings and kept anaesthetised with ether through oxygen and a Wright's cat mask.

Ether anaesthesia is profound but seems to be reasonably safe. We have also used it satisfactorily for caesarean section which is a straightforward operation as in other small domestic species.

Yours faithfully,
K. G. MORGAN,
D. H. W. BROWN.

Llanover Lodge,
Welsh Street,
Chepstow.
October 16th, 1959.

DISEASES OF ANIMALS ACT, 1950—GREAT BRITAIN
Summary of Returns of Confirmed Outbreaks of Scheduled (Notifiable) Diseases

Period		Anthrax	Atrophic Rhinitis	Foot-and-Mouth	Fowl Pest	Sheep Scab	Swine Fever
1st to 15th Sept., 1959		19	1	—	24	—	65
Corresponding period in	1958	6	1	—	26	—	58
	1957	2	—	1	30	—	38
	1956	33	—	19	30	—	36
1st Jan. to 15th Sept., 1959		167	1	9	501	—	844
Corresponding period in	1958	112	5	114	503	—	956
	1957	254	6	40	581	—	690
	1956	1,118	8	99	487	—	565